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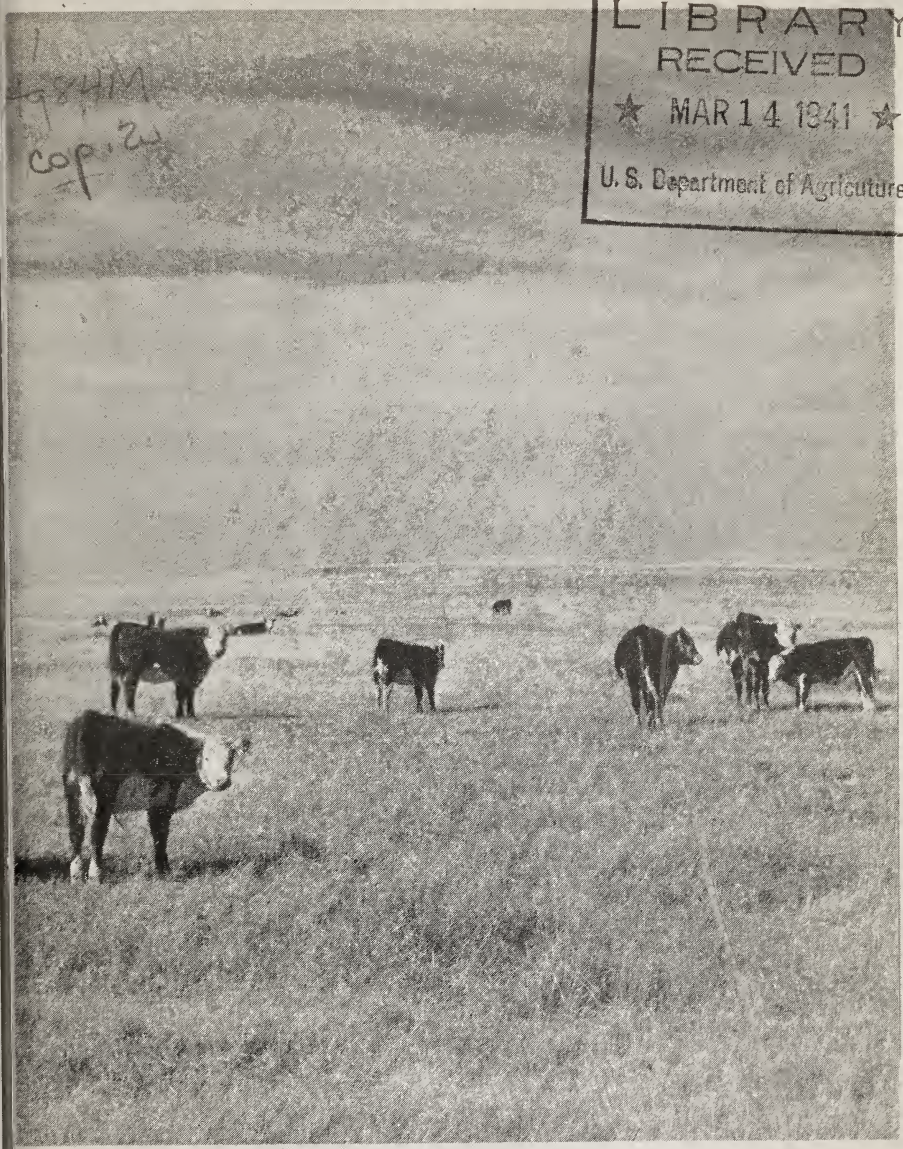

RANGE CONSERVATION PRACTICES FOR THE GREAT PLAINS

U. S. DEPARTMENT OF AGRICULTURE
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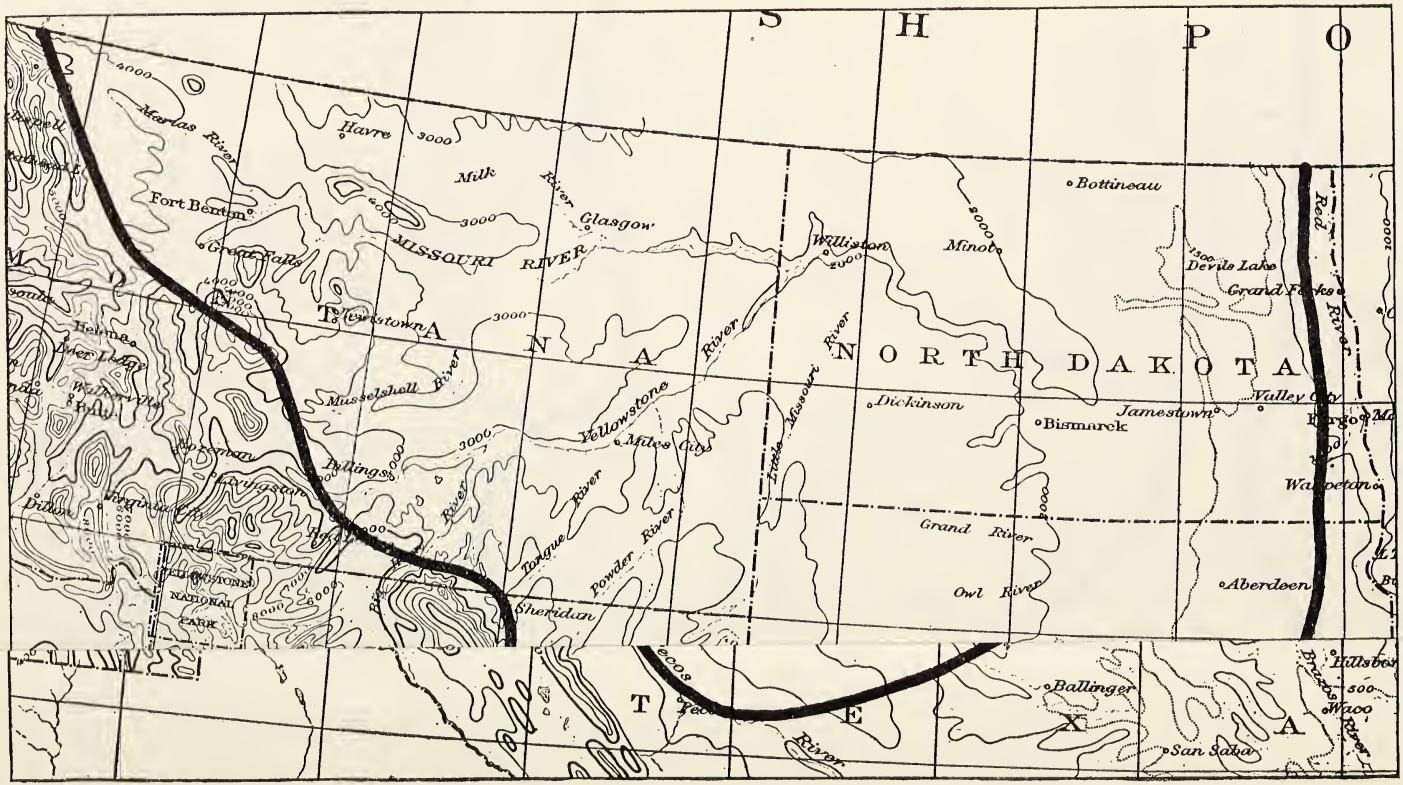

FIGURE 1.—Map of the Great Plains region.

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Issued December 1940

Range Conservation Practices for the Great Plains

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INTRODUCTION

The improvement and maintenance of the grazing resources of the Great Plains are dependent on the employment of sound range conservation practices that will foster the growth of desirable forage plants and maintain the productivity of the soil. It is the purpose of this bulletin to present the more important of these essential range conservation practices. For the Great Plains these differ but little from those needed in other range areas; the main difference lies in the degree and the timing of the practices that are used rather than in the kind.

The Great Plains, as delimited for the purposes of this publication, comprises the land area bounded on the west by the Rocky Mountains, on the east by a line which approximately conforms to the 98th meridian, on the north by the International Boundary Line, and on the south by the Pecos River where it flows in an easterly direction in Texas (fig. 1). The Great Plains region is about 1,300 miles long and ranges in width from approximately 200 to 700 miles.

There are approximately 360 million acres of land within its boundaries, of which about 63 percent is grazing land. Its grazing and forage crop resources supply feed for nearly 12 million animal units yearlong.

FIGURE 1.—Map of the Great Plains region.

258100°—40 (Face p. 1)

GRAZING HISTORY

The Great Plains have been the homeland of grazing animals for geologic ages. The fossil remains of the four-toed horse are found in deposits that geologists believe to be 45 million to 50 million years old. The evolution of the horse from that remote age to a comparatively recent period is recorded in the fossil beds in many areas of the Great Plains. Other mammals, such as the elephant, camel, and buffalo also roamed these primeval grazing lands.

Early American explorers found millions of buffalo, antelope, and other animals living on the vast steppes between the Mississippi and the Rocky Mountains. After the Spanish conquistadors introduced the European horse, the Indians took to hunting the buffalo on horseback and became the forerunners of the cowboys of the West. With the western migration of the white man, the wild game was doomed to a heavy reduction in numbers, and by 1889 the vast herds of buffalo in North America had dwindled to less than 1,000 head. Hard on the heels of the disappearing buffalo came the lowing trail herds of cattle from Texas. With the close of the Civil War, western migration and a stimulation of eastern business opened a heretofore unparalleled cattle market. The business stagnation brought about by the Civil War caused an overproduction of cattle in Texas. With the opening up of northern and eastern markets, in the late sixties and early seventies, great herds of cattle trailed north from Texas and Mexico to take over the ranges of the Great Plains relinquished by the buffalo.

The story of the yielding of the open range to barbed wire and the plow is well known. Faulty land-settlement policies encouraged the homesteading of parcels of land too small to produce a living for their owners, until farm and ranch reorganization became one of the major problems. These factors, plus serious drought, soil blown from adjacent fields, insect plagues, and overstocking have wholly or partly destroyed the forage and watershed values of vast areas on the Great Plains.

There is now an active program of adjustment under way to correct the derangements wrought on the range by plowing land unsuited to farming. Scattered throughout the region are many excellent demonstrations of the application of sound range-management practices where successful stockmen have maintained their forage resources under long-time use. These practices have the sanction of experiment stations and range men who have specialized in testing their value. Ranges of ranch operators and owners who have handled their ranges properly are practical examples of sound management and serve as valuable reference areas for range men.

PRESERVATION OF VEGETATION ON RANGE LAND IS ESSENTIAL FOR SOIL AND MOISTURE CONSERVATION AND AGRICULTURAL ECONOMY

One of the most important objectives in the sound management of range lands is to bring about improvement in the native vegetation so that this protective cover will properly sustain the livestock industry by furnishing the necessary protection to the soil and the watersheds. A soil, to be fertile and capable of maximum plant production, must contain the essential plant elements and an abundance of

microscopic life that has the power of converting minerals and nitrogen into forms available for plant consumption. The microscopic life thrives in decaying organic refuse from plants, which in turn benefit from the plant food thus made available.

The roots of most desirable pasture grasses are found in greatest abundance in the first 15 inches of the soil, and when abundant and vigorous under good management, they offer a binding understructure resistant to the eroding forces of wind and water. This layer of roots with the accompanying turf enables the soil to absorb and retain moisture, without which plant life cannot survive. Plant leaves and stems shield the soil against the impact of downpouring rain. When unprotected, the soil is muddied by pelting raindrops and the fine soil particles tend to seal the microscopic pores through

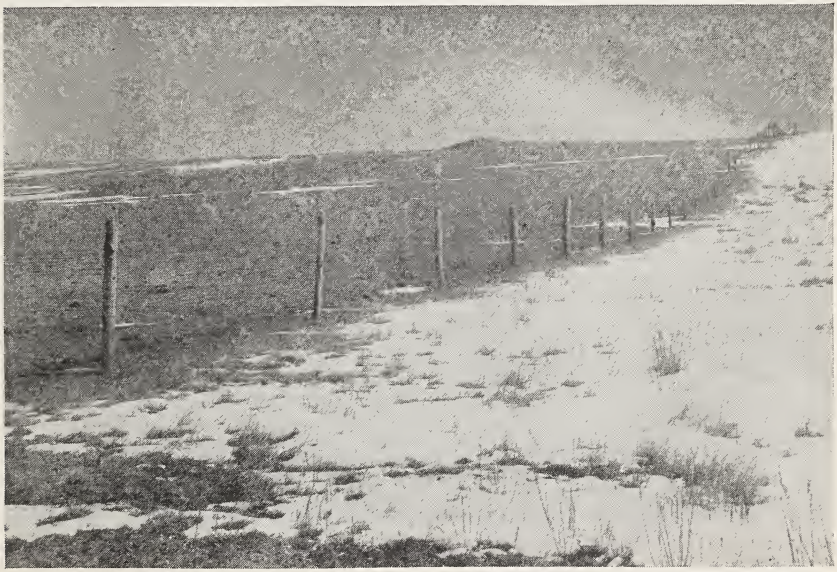

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FIGURE 2.—Contrast of snow retention between overgrazed area on the left and ungrazed area in the enclosure on the right. The only variable is in the density and the height of grasses. (Douglas County, Colo., Apr. 9, 1938.)

which the water and air enter. Soil absorption of water is appreciably less when the water is muddy. The surface stubble also acts as a buffer, holding and slowing up the flow of water and, in winter, catching and holding snow (fig. 2), thus increasing the penetration of water into the soil. The removal of this highly useful cover causes many of the soils to shed water very rapidly into rills that may combine to cause floods.

When too intense grazing is introduced into the semiarid range country, the normal trend in plant succession is reversed and there appears a type of vegetation less able to protect the soil or provide adequate forage for livestock. Indications of this retrogression are abundant over much of the grazing area in the Great Plains. The most palatable forage species are the first to be thinned out by hungry stock, and in the absence of competition by the more desirable plants,

less palatable species become more abundant and the range deteriorates. Many of these less palatable species, such as thistles, pigweeds, sunflowers, and certain perennial shrubs are less desirable also from other standpoints. Most of them have single taproots incapable of binding the soil into durable sod. Consequently the less protected top layer of fertile soil is subjected to serious erosion and may be transported for many miles by wind or by torrential rains that wreak havoc in heavy floods. (Figure 3.) Adequate protection to such soils is possible only with increased vegetation, and this, in turn, is often feasible only by making greater moisture supplies available to the plants.

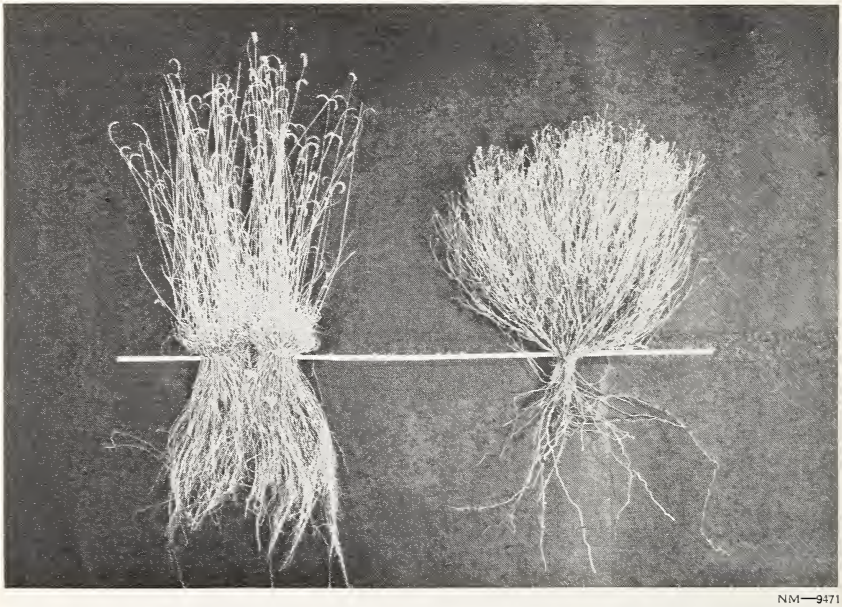

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FIGURE 3.—Perennial grasses, with their dense mat of fibrous roots, are far more effective in holding the soil than the sparsely rooted shrubs. (Bernalillo County, N. Mex., Jan. 15, 1938.)

FORAGE PLANTS AS MANUFACTURING UNITS

Forage plants are, in reality, manufacturers of feed. They do not gain their food ready-made from the soil, but take up water, minerals, and nitrogen through the root systems and deliver them to the leaves. The green leaves, with the help of light, build up more plant food which is used for further growth, production of seeds, and food to be stored in the roots for winter use and the beginning of new growth in the spring. About 85 percent of the weight of most herbaceous plants is made up of water obtained through the roots. The remainder is solid matter, including organic products and mineral constituents, supplied by the soil in soluble form, and by carbon dioxide taken in through the leaves. The physiological development of plants is highly important from the standpoint of forage production, for if the leaves are eaten so closely that they cannot perform their normal function of food building and storage, the plant becomes weakened, and with continued overuse finally dies and is crowded

out by more aggressive weeds or shrubs that are not grazed. Overgrazing on ranges has the same effect on desirable forage plants that clean cultivation of cropland has on noxious weeds. In the latter case, the leaf growth is kept down to the point where the root system of the weed eventually starves to death. On ranges, continued close cropping prevents the development of sufficient leaf growth to maintain the reproduction and vigor of the growing plants.

RELATION OF PLANTS TO WATER RUN-OFF AND SOIL MOISTURE

Under sound range management, plant associations are allowed their maximum expression in terms of density, volume of forage growth, and composition. Soils, protected by this mantle of vegetation, remain mellow and receptive to maximum infiltration during rains. Conversely, under improvident range use, inferior plants crowd out the better ones, and with close grazing the soil is bared to the destructive forces of the elements. A quantitative expression of run-off under these two conditions is shown by a plot study made on properly and improperly managed adjoining ranges near Cheyenne Wells in eastern Colorado by the Soil Conservation Service in June 1937.

Water, in equal quantities and at the same rate, was applied artificially at the rate of 2.65 inches per hour to each of two plots of loamy sandy soil by means of an improvised rain maker. Run-off was trapped and measured in a catchment tank, and soil-moisture penetration studies were made immediately following the application of the artificial rain. The slopes on the two plots were comparable and the soils, a deep, structureless loamy sand, were of the same origin. A fence separated the two ranges where the tests were made. Grazing had been withheld on both ranges prior to the date of the study.

TABLE 1.—*Comparison in plant composition, height, and density of properly and improperly managed ranges*

Plants	Test No. 1 Properly managed range [1]		Test No. 2 Improperly managed range [2]	
	Height	Density of cover	Height	Density of cover
	Inches	*Percent*	*Inches*	*Percent*
Blue grama (*Bouteloua gracilis* (H. B. K.) Lag.)	4	5	2	7.5
Little bluestem (*Andropogon scoparius* Michx.)	4	.1		[3]
Prairie sandgrass (*Calamovilfa longifolia* (Hook.) Scribn.)	16	3		[3]
Needle-and-thread (*Stipa comata* Trin. and Rupr.)		[3]		[3]
Fringed sagebrush (*Artemisia frigida* Willd.)	6	.1	6	1.0
Stickweed (*Cryptanthe* spp.)	6	.3	6	1.5
Buckwheat (*Eriogonum simpsoni* Benth.)		[3]		
Thelesperma (*Thelesperma gracile* (Torr.) Gray)		[3]		
Beardtongue (*Pentstemon* spp.)		[3]	6	.5
Sunflower (*Helianthus annuus* L.)		[3]		
Lambsquarters (*Chenopodium album* L.)		[3]		
Red three-awn (*Aristida longiseta* Steud.)			6	.1
Broom butterweed (*Senecio spartioides* Torr. and Gray)				[3]
Butterweed (*Senecio oblanceolatus* Rydb.)			6	.1
Talinum (*Talinum parviflorum* Nutt.)				.1
Total cover		8.5		10.8

[1] This plot lost 10 percent of its allotted 2.65 inches of rainfall in an hour.
[2] On this plot the run-off was 29 percent or virtually 3 times what it was on the properly managed range.
[3] Trace.

Several significant conclusions relative to the importance of volume growth of vegetation in the control of run-off may be drawn from the results of this study. On the properly managed range a large quantity of new and semidecomposed plant litter covered the soil and provided a filter to permit the quick absorption of rainfall. As the result of the continued close cropping to which the improperly managed range was subjected, there was little volume growth to break the impact of the rain and no litter remained to keep the soil open and receptive to rainfall.

Moreover, the raw soil was exposed to the sun and the action of the wind. It was baked hard, and the few plant fragments, not eaten by livestock, were subject to removal by the wind.

The improperly used range had a density of 10.8 percent, which was made up of 69 percent grama grass and 31 percent of unpalatable weeds and grasses. The properly managed range had a density of 8.5 percent, of which 95 percent was palatable grasses and 5 percent fringed sage and stickweed, both species unpalatable for cattle. Volume growth and plant vigor on the properly managed range were notably greater even though no grazing had been practiced on either range during the spring the study was made.

Prairie sandgrass is not ordinarily a dominant plant in this particular climate. However, under late spring use and restricted stocking, it will thrive where the permeable sandy-textured soils yield the moisture necessary for its perpetuation. When grazing is gaged to encourage the maintenance of a thrifty stand of prairie sandgrass and blue grama on such soils, the yield of total digestible nutrients per acre is greater than when the grazing is intensified to encourage the lower successional stage of blue grama and unpalatable weeds.

Other investigations have shown that plants intercept large quantities of precipitation, and by preventing rain from striking the soil directly have a marked effect upon decreasing run-off and erosion.

RECOMMENDED RANGE CONSERVATION PRACTICES

Stocking Within Grazing Capacity Is the Key to Good Range Management

Avoidance of stocking range lands beyond their grazing capacity is a prime requisite in maintaining such areas in maximum forage production for livestock feed and erosion control. If a range is deteriorating because of overgrazing, any attempt to correct the condition by measures which do not take into account proper stocking will usually result in further depletion and erosion and make restoration more difficult.

Overgrazing is a faulty practice that has never been found to be economical. It is usually unintentional on the part of the operators who are not familiar with the physiological requirements of plants and who fail to recognize that the range is slowly deteriorating. Sometimes overstocking is temporarily necessitated by unavoidable circumstances, as it is not always possible to dispose of excess livestock promptly at the beginning of a drought. Sometimes overgrazing is condoned in the belief that economic stresses make it necessary. Overinvestments may make it impossible to graze pastures correctly and still provide an immediate profit. However, an unwise

investment is made worse by overgrazing, as continued overgrazing further reduces the grazing capacity and will ultimately preclude any possibility of a profitable operation. The changes that take place in vegetation through overgrazing are brought out in table 2 which shows a comparison between two adjoining ranges near Huron, S. Dak. These ranges have similar soils and slopes. One has been properly grazed for at least 20 years and the other has been overgrazed until at present it has only 40 percent of the grazing capacity of the former.

TABLE 2.—*Contrast in plant composition and density between properly grazed and overgrazed ranges*

Plants	Density[1] of pasture with grazing capacity of 17.5 acres per animal unit [2]		Density[1] of pasture with grazing capacity of 40 acres per animal unit [3]	
	Average	Total	Average	Total
	Percent	*Percent*	*Percent*	*Percent*
Western wheatgrass (*Agropyron smithii* Rydb.)	2.17		0.70	
Blue grama (*Bouteloua gracilis* (H. B. K.) Lag.)	4.90		1.25	
Side-oats grama (*Bouteloua curtipendula* (Michx.) Torr.)	.05		.1	
Buffalo grass (*Buchloe dactyloides* (Nutt.) Englm.)	1.15		.85	
Density of major grasses		8.27		2.90
Junegrass (*Koeleria cristata* (L.) Pers.)				
Kentucky bluegrass (*Poa pratensis* L.)				.60
Dryland sedge (*Carex stenophylla* Wahl.)		.05		
Aster (*Aster* sp.)				.05
Annual peppergrass (*Lepidium densiforum* Schrad.)		.07		.95
Lambsquarters (*Chenopodium album* L.)				.65
Russian-thistle (*Salsola pestifer* A. Nels.)				1.20
Curlycup gumweed (*Grindelia squarrosa* (Pursh) Dunal)				.55
Sunflower (*Helianthus annuus* L.)				.15
Horseweed (*Iva xanthifolia* Nutt.)				.1
Ragweed (*Ambrosia trifida* L.)				.1
Total density		8.39		7.25

[1] Density estimates computed by the point-observation method.
[2] 98 percent of forage consists of four major perennials, remainder annuals and weeds.
[3] 40 percent of forage consists of four major perennials, remainder annuals and weeds.

Results obtained by the U. S. Forest Service on the Jornada Experiment Range in southern New Mexico, by the New Mexico Experiment Station at the same location, by the Texas Range Experiment Station at Sonora, Tex., and by the U. S. Range Livestock Experiment Station at Miles City, Mont., as well as the experience of numerous ranch owners indicate the value of moderate grazing in conserving range resources and achieving stability of ranch economy.

Where overstocking is a problem, the securing of additional range lands, outright sale of excess animals, or the provision of additional supplemental feed is necessary. Ordinarily the sale of surplus stock or culling of the herd will meet the requirements of sound management most readily. Stockmen on the Soil Conservation Service demonstration areas are following this plan. As many as 25 percent of the livestock on some demonstration areas have been disposed of to meet grazing capacity requirements. In many cases these reductions, involving the disposal of old, broken-mouthed, unproductive animals and the replacement by animals of high quality, have been

made to the distinct advantage of the operator and with immediate benefits to the range. Past experience on some ranges shows that breed improvement and culling have made it possible for 2 cows to give the same net income that it formerly required 3 to produce. This means that 200 head of improved and thrifty stock have given the same net returns as 300 head of scrub or old, broken-mouthed stock. In many instances, the replacement of nonproductive stock with fewer numbers of well-bred animals will largely correct present overstocking abuses. There are many ranches where excellent range-management practices, in conjunction with breeding and culling programs, are resulting in the production of superior livestock. The front cover carries a photograph of well-bred Herefords on excellent range land within the Land Utilization project, Roundup, Mont. The operator combines a practice of maintaining excellent breeding stock with well-managed range lands.

Use of Range Areas During Proper Seasons

Correct seasonal use of pastures is highly important in maintaining a vigorous and productive range. Many factors are involved in the determination of proper seasonal use. Ranges grazed during the critical period of leaf and seed production must be lightly used during this time in order that the plants may achieve their maximum development for continued production. Pasture rotation, applied in the use of various portions of the range, is important in allowing rest periods during the critical growing season. Temporary pastures, supplemental dry feed, and silage have their greatest values during the early growing season in relieving seasonal overuse of permanent ranges.

Certain ranges may only be used during the periods when snow or rains are frequent. On ranges where poisonous plants may be dangerous during short periods, proper seasonal grazing will make unnecessary the use of hazardous areas until after the toxic plants have lost their virulence. Rough areas offer winter protection when flat, shelterless prairies are definitely hazardous in stormy weather.

Forage composition may also dictate the season of use. Browse types, having forage that protrudes through several inches of snow, are available for winter grazing when grasslands may be covered. In all instances, the proper season for the use of the ranges should be determined, and when ready for use they should be stocked to proper grazing capacity.

Systems of Grazing

Deferred grazing is of particular value as a means of aiding the recovery and increase of desirable forage plants on depleted ranges. Under this practice, the livestock are withheld from a portion of the range during the first part of the grazing season. This permits the forage plants to regain their vigor and produce a seed crop. After the seed has matured, the range may be grazed. It is usually desirable, in order to obtain the greatest benefits from deferred grazing, to defer grazing on the same range 2 years in succession. This eliminates the danger of young seedlings being pulled out of the ground. In many instances, benefits obtained by the use of this practice are equal to those resulting from complete protection for the entire season.

The division of large range areas into smaller units and rotation of their use are management practices under which the benefits of deferred grazing may be obtained on separate units each season, and eventually over the entire range. Grazing studies on the effects of different systems and intensities of grazing upon the native vegetation at the northern Great Plains Field Station, Mandan, N. Dak., indicated that steers grazed at the rate of one 2-year old steer to 5 acres when grazed on a pasture continuously, showed a gain per head approximately 35 pounds less than those grazed on a pasture divided into 3 equal parts and grazed at the same rate of stocking under the deferred and rotation system.

Stocking With Kind of Livestock Most Suitable to Range

The evaluation of range to determine the particular kind of stock best suited for its most efficient use is important. This determination should be based on the character of the forage, topography, water supply, parasites and insect pests, the grazing habits of the animals and the relation of grazing to timber production, game production, and industrial developments that are allied to the grazing operations of the range. The preference of the grazier for certain kinds of stock should also be considered, as he seldom succeeds with livestock in which he is not interested.

Grass ranges are used to better advantage by horses and cattle, while browse is preferred by sheep and goats. Although sheep and goats thrive on grass ranges, they dislike the coarser parts of forage plants and utilize only the more tender shoots, basal leaves, and seed heads. Cattle will graze many browse species, but on areas where the forage consist mostly or entirely of browse the animals will usually delay grazing the shrubby plants until the better perennial grasses have been overutilized.

Flat or rolling ranges are used more advantageously by cattle than rough areas. Cattle will thrive on rough, broken ranges, but they tend to congregate in the valley grasslands or open parks, causing local overgrazing in such spots and underuse on the hillsides and heavy brush areas. This difficulty can be corrected by increasing watering facilities, fencing, salting in unused areas, or by herding. Extra bulls are likewise needed in rough country to assure a normal calf crop. The cost of such additional measures is often prohibitive. However, herded sheep can use such places much more effectively than loose stock. Rough mountainous areas are not well suited for use by breeding herds of cattle, whereas sheep and steers find them excellent grazing grounds. Sheep use flat or rolling land as well as cattle or horses, but can be made to use rough rocky ranges, especially if their movements are guided by a herder. Where local custom establishes the class of stock using ranges, adequate range-maintaining and range-improving practices must be adopted.

Proper Distribution of Livestock

Artificial means are usually necessary to obtain grazing on the rougher portions of a range and areas remote from water, and to prevent undue concentration and heavy use in other portions.

FENCING

Fences can be made to play an important part in range management. They are often necessary to eliminate local overgrazing brought about by rough topography, the peculiar feeding habits of animals, or poor water facilities. They are sometimes necessary to shut out trespassing livestock, to enclose poisonous plant areas, and to apply deferred and rotation practices. In many instances the need for fencing cattle ranges can be reduced by the proper use of salt and by providing additional stock water.

Where losses from predatory animals and theft can be kept low, handling sheep under sheep-tight fences may be less expensive than open-herding methods. The animals spend their full time in early mornings and late evenings grazing instead of traveling to and from the bed grounds. Sheep on properly fenced range graze quietly in open formation, and being undisturbed, trample out less grass than when herded. Studies indicate that grazing capacity under this method may be increased from 25 percent to 35 percent over the herding system, and lambs have shown 8 to 10 pounds more weight at market time.

SALTING

Salt is essential in the diet of grazing animals. The quantity needed on the range depends somewhat on the salt content of feeds and drinking water, the presence of natural "licks," and loss from weathering, but chiefly upon succulence of forage. If sufficient salt is not available to grazing animals, their thriftiness is impaired and proper use of the range is not obtained. In general, about 2 to 2½ pounds per cow unit a month are usually adequate when the forage is succulent. Satisfactory annual salt allowances for average yearlong ranges appear to be about 20 pounds a head for cattle and 3 to 4 pounds a head for sheep and goats. Salt losses from weathering are generally about 10 percent a month with block salt when placed on the ground.

Since salt attracts cattle, it can be made an important and economical aid in the local control and distribution of livestock. Systematic salting can be used on all ranges to lessen undue grazing on areas where the animals tend to congregate, if salt is placed on those portions of the range normally only lightly used.

Care should be taken to avoid locating salt grounds on areas too heavily used, those difficult of access, and those where serious erosion, forage, or damage to trees may result. On cattle ranges, salt should be placed at readily accessible places on ridges, knolls, or benches, in parklike openings in timber and brush and on the more level areas. Slightly used areas and patches of permanently low forage value, such as rocky knolls, should be selected rather than places fully grazed (fig. 4). The location of salt in relation to water depends upon a number of factors including topography, nature of feed, range condition, and condition of the cattle. It should ordinarily be placed at a reasonable distance from water, preferably not nearer than half a mile to a water supply in large range units, but never beyond a practicable walking distance for the animals. A shift in location of salt grounds should always be made in time to prevent decided damage to the range in the vicinity of the salt ground.

COLO—3288

FIGURE 4.—Proper distribution of salt aids in the distribution of livestock and the proper utilization of range lands. (Elbert County, Colo., Aug. 29, 1938.)

MONT—10133

FIGURE 5.—This picture illustrates three significant infractions of proper range management: (1) Sheep used this bedground 3 weeks; (2) the bedground is only 300 yards from the stock water pond in the upper right background; (3) stock-water dam has been placed in steep, badly eroded range area which should be stabilized before use. (44 miles north of Miles City, Mont., Oct. 14, 1939.)

HERDING

The practices of open herding and bedding out of sheep are desirable in gaining most efficient use of range, reducing trampling of forage and obtaining bigger gains in livestock weights. Shading up at water holes should be avoided. Small bands damage ranges less than large ones and the lambs from small bands usually make greater gains. However, it is doubtful whether, under ordinary conditions, herds of less than 400 ewes and their lambs will justify herding expense. Seldom should summer bands of ewes exceed 800 to 1,000 in addition to their lambs, although where the range is smooth, water plentiful, and herding difficulties at a minimum, larger bands may be feasible. Topography imposes a limit on the size of bands (fig. 5). The rougher the range, the smaller the band should be to conform with best grazing practices. Dogs should be used with great care, as their overuse causes bunching, milling, and losses in lamb weights, as well as unnecessary trampling of the forage.

Sheep should not be bedded in one place more than three nights in succession. In many instances, small operators can reduce herding costs by establishing consolidated bands, each owner paying his proportionate share of the outlay. Although bedding out may be unpopular with large operators because of the alleged inconvenience, the increased weight of lambs and lessened injury to the range make it a very desirable and sound practice.

STOCK WATER

Adequate water and proper distribution of watering places are essential to proper range use. Watering places should be available in such numbers and so distributed that excessive trailing, which destroys the vegetation (fig. 6) and reduces gains in weight, will be eliminated. Climate, topography, soils, vegetation, and class of stock are important factors to be considered in locating and developing water supplies. On flat or rolling ranges it is desirable to have cattle travel not more than 2½ miles to water, and in areas of rough topography, heavy timber, or brush, not more than ½ to 1 mile. Sheep should ordinarily not be required to travel more than 1 mile in mountainous, brushy, timbered, or rocky country, nor more than 3 miles on flat, open, and smooth ground.

Water supplies should not be provided on areas that are focal points of erosion. They should be placed where they will be accessible from several directions and, if possible, away from natural concentration points.

Stock water dams should not be located in deep-sided gulches, swamps, or bogholes unless they are fenced and the water piped to a readily accessible trough or tank. Their location in main drainages where silting and heavy floods are a problem should be avoided. Sometimes it may be advisable to put the dam in a side drainage and divert water into it, allowing the water to spread over sod and dump its debris before it reaches the pond (fig. 7). All dams should have adequate spillways. Where possible, the spillway should be so designed that water may be spread on grasslands below the dam.

In certain areas where soils are mostly of a shale origin, the water may be impregnated with salts to the point where stock refuse it

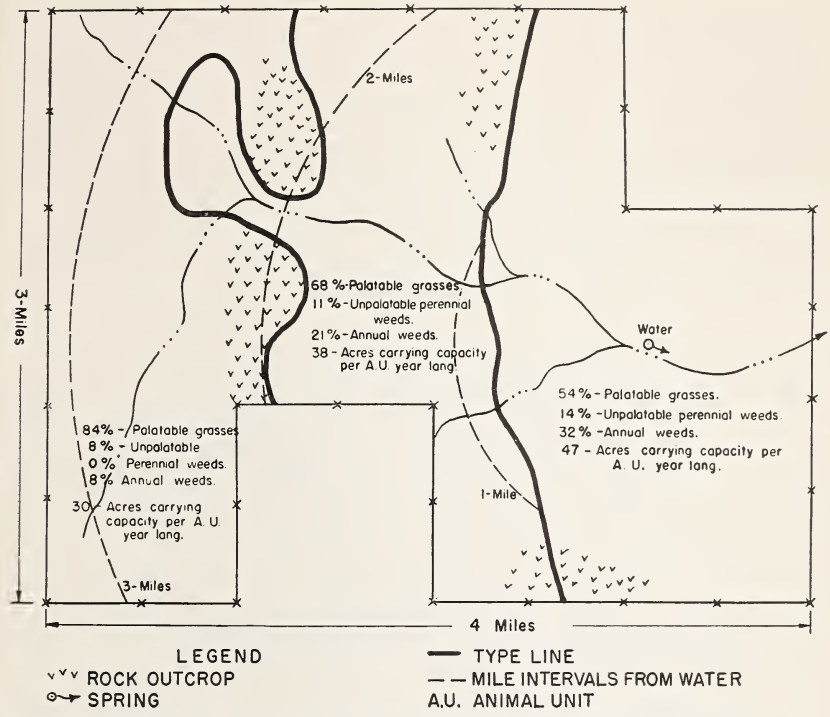

FIGURE 6.—Range deterioration due to improper stock water distribution.

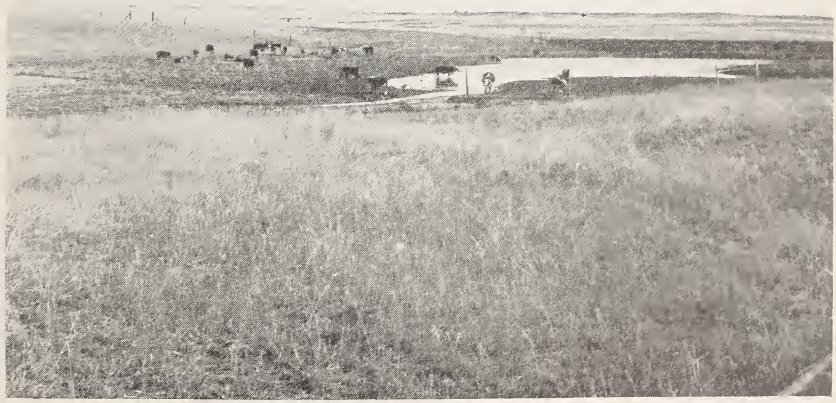

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FIGURE 7.—Properly constructed stock water dams are easily approached by livestock from all sides. Note fenced-out desilting area and wildlife refuge in foreground. (Musselshell County, Mont., Oct. 17, 1939.)

except in cases of extreme thirst. As livestock seldom consume water that contains a detrimental amount of salt, development of water in such places would result in a useless expenditure of money.

It is essential that a sufficient volume of potable water be furnished to meet the livestock needs on the area grazed. There are many factors that affect the water requirements of livestock, such as season, climate, vegetation, and management practices. Cattle, horses, ewes, and lambs should have access to water daily. Dry ewes on winter browse ranges can go 2 days or longer without water and maintain their vigor. Cows and horses require about 10 gallons a day, and sheep and goats about 1 gallon.

Control of Stock-Poisoning Plants

Poisonous plants, not usually comparable in palatability to desirable perennial forage plants, are grazed principally when no reserve of desirable vegetation is present. Stock hard-pushed on long trails often die as a result of eating poisonous plants, as such plants are most readily available to the hungry animals. The cheapest and most satisfactory method of preventing stock losses from poisonous plants is to have an ample supply of palatable forage at all times.

Adequate water and proper salt distribution will also do much to reduce losses from poisonous plants. If livestock are forced to concentrate in areas infested by poisonous plants in order to obtain water and salt, the danger is increased. Seasonal grazing will lessen danger from such plants as death camas. A change in kind of stock may be used as a means of controlling death losses. For example, a change from sheep or goats to cattle may prevent heavy losses on ranges infested with bitter weed, which is not eaten by cattle. Similarly, on areas at higher elevations infested by larkspur, which affects only cattle, a change from cattle to sheep will ordinarily solve the problem and permit full use of the range.

Mechanical or chemical eradication or control of noxious plants is not warranted when proper grazing will do the job more cheaply. Such methods are justified only on small, restricted areas. Fencing of areas to keep livestock out may be the cheapest method of eliminating losses from small, heavily infested localities.

USE OF SUPPLEMENTAL FEEDS IN CONNECTION WITH RANGE CONSERVATION

When To Use Supplemental Feeds

The production of supplemental feed is a desirable practice in all sections where it is economical and practical. Its use is in keeping with the concepts of good range management and proper land use.

In areas unsuited to cultivated crop production, the development of native or cultivated meadows for hay production is in many instances practical and advantageous.

The use of supplemental feed has the following purposes:

1. To supplement native ranges and pastures during normal seasons.

2. To relieve native ranges and pastures during seasons of subnormal forage production.

3. To make deferred grazing possible on areas where the vegetative cover is injured by early spring grazing.

4. To build up feed reserves or emergency feed supplies for use during one or more subnormal seasons. The purpose of the reserve is not to provide feed for additional livestock, but to assure maintenance of the livestock in adverse years.

A distinction should be made between roughages and concentrates for specific use. Supplemental feeding in the form of roughages is not satisfactory under certain range conditions where concentrates may logically be used.

Supplemental feed, more especially concentrates, should be used for the purpose of improving the animal produced and not to encourage purchase of additional livestock that will lead to use of range forage beyond its grazing capacity.

Supplemental feed promotes the well-being of livestock by means of additional energy supplied, or by the addition of protein, minerals, and vitamins. The values and limitations of supplemental feeds in supplying these needs should be recognized, and corrective measures indicated where they are needed.

In the production of supplemental feed crops, it is important to provide for kinds of crops, seasons of use, and field lay-outs, which will give the greatest possible protection to the soil as an erosion preventive. This is especially true in areas or fields subject to severe erosion.

Use of Supplemental Feed Has Increased With Range Deterioration

Supplemental feeds have played an important part in the development of the range industry. Prior to 1880 there was relatively little improved farm land west of the 100th meridian. Livestock depended almost wholly on the range. When that failed, livestock starved. Since then, there has been a marked increase in the percentage of supplemental feed utilized by the livestock in the Plains States, chiefly in the form of hay, grain, straw, stubble aftermath, and irrigated-pasture growth, also beet pulp and other byproducts. In 1880, in the 11 Western States, 96 percent of all livestock feed was derived from the range. In 1890, this had been slightly reduced to 95 percent; in 1900, to 92 percent; in 1910, to 84 percent; in 1920 and 1930, to 80 percent; and in 1935, to 71 percent. Accordingly, in 1880, the dependence of livestock on the range was at its maximum. At the present time, the production of supplemental feed and irrigated pasturage is four to five times as great as in 1880.

The steady decrease in the supply of native forage as the result of too many grazing animals has been obscured by the fact that herds have continued to be carried largely through the increased use of supplemental feeds. Production costs, however, have mounted with the increased use of such feeds, which cost two to four times more than cheap range feed grown on well-managed ranges.

Disposal of Nonprofitable Animals a Means of Reducing Feed Costs

Stocking range lands at their estimated grazing capacity is the key to good range management. In fact, a stabilized and profitable industry is not assured merely by maintaining large herds, unless overgrazing is avoided and sufficient feed is produced or purchased to support the numbers carried. It is good practice to cull out the less desirable, nonproductive and unprofitable animals from the herd. When adequate range and supplemental feeds are not available and it becomes necessary to cut down the herd, the least profitable animals should be disposed of, thus carrying fewer animals and leaving

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Figure 8.—Adequate winter feed supply stacked on a ranch in Colorado. It consists of blue grama hay and sorghums. The grama grass was cut in bottom lands. The sorghums were raised on contour strips. (Cheyenne County, Colo., Nov. 15, 1938.)

enough vegetation on the range for protection against erosion. This procedure makes possible the production of sufficient forage to insure a high-percentage calf and lamb crop, a heavy wool clip, and heavy, well-conditioned calves and lambs at weaning time.

Reserve and Emergency Feeds

Where undue hardships will be experienced by the disposal of excess animals during the period required to restore depleted ranges, the necessary feed requirements may be met by providing additional feed supplies (fig. 8). The provision of adequate reserves of feed supplies will also safeguard the ranges against years of drought when the natural forage supply is inadequate for the needs of livestock and erosion control.

Kinds of Supplemental, Reserve, and Emergency Feeds

The conditions under which supplemental, reserve and emergency feeds can be produced vary widely according to species, rate of seeding, time of seeding, and necessary seedbed preparation. In the Great Plains, the feeds may come from such crops as meadow hay, alfalfa, clover, small grains, sorghums, root succulents, silage crops, and supplemental temporary or permanent pastures. Particular attention should be given to selection of species and to practices that are adapted to the particular conditions of soil, moisture, use, and other factors that make for efficient production.

The use of perennial forage plants should be encouraged on erodible soil areas. The use of legumes should be given full consideration when planning the supplemental roughage feed program, on account of their high feed values, especially in proteins and minerals.

TEMPORARY AND PERMANENT PASTURES

The practice of retiring submarginal cash-crop lands, not needed for the production of supplemental feed crops, to annual, biennial, or permanent pastures is not only an aid to permanent agricultural stability, but is of direct benefit in lessening the strain on existing permanent ranges. Annual pastures of Sudan grass, small grains and millet, and biennial pastures of fall rye and sweetclover have proved successful in the Great Plains, having withstood the hardships of dry weather, wind, and the competition of weeds. Satisfactory results have likewise been obtained in the establishment of perennial grass pastures in some parts of the northern Great Plains where approximately 117,700 acres of Government land have been seeded to crested wheatgrass and western wheatgrass by the Soil Conservation Service. Several thousand acres of other lands have been seeded by private and public agencies with similar results. It has been found that crested wheatgrass pastures can be utilized earlier in the spring than native range. They make excellent lambing and calving pastures for ranchers who have breeding herds. The abundance of early succulent feed is conducive to the production of milk. When moisture conditions are favorable in the fall these pastures can again be utilized.

MECHANICAL TREATMENT

In general, proper grazing control, in keeping with the principles described in this publication, will be sufficient to effect stabilization of most range lands. Certain mechanical treatments may be of value in improving range conditions, increasing forage production, and conserving soil and moisture. These include water spreading, contour furrowing and contour ridging, and gully control. The use of these treatments, and the conditions under which they may be economically and practicably applied should be thoroughly investigated by the ranch owner. The most competent technical advice that is available should be obtained before mechanical measures for range conservation are undertaken.

CONSOLIDATION OF RANGES

The checkered pattern of ownership of lands in the Great Plains, partly the result of improvident land-settlement policies, is one of the principal difficulties confronting the range-livestock industry.

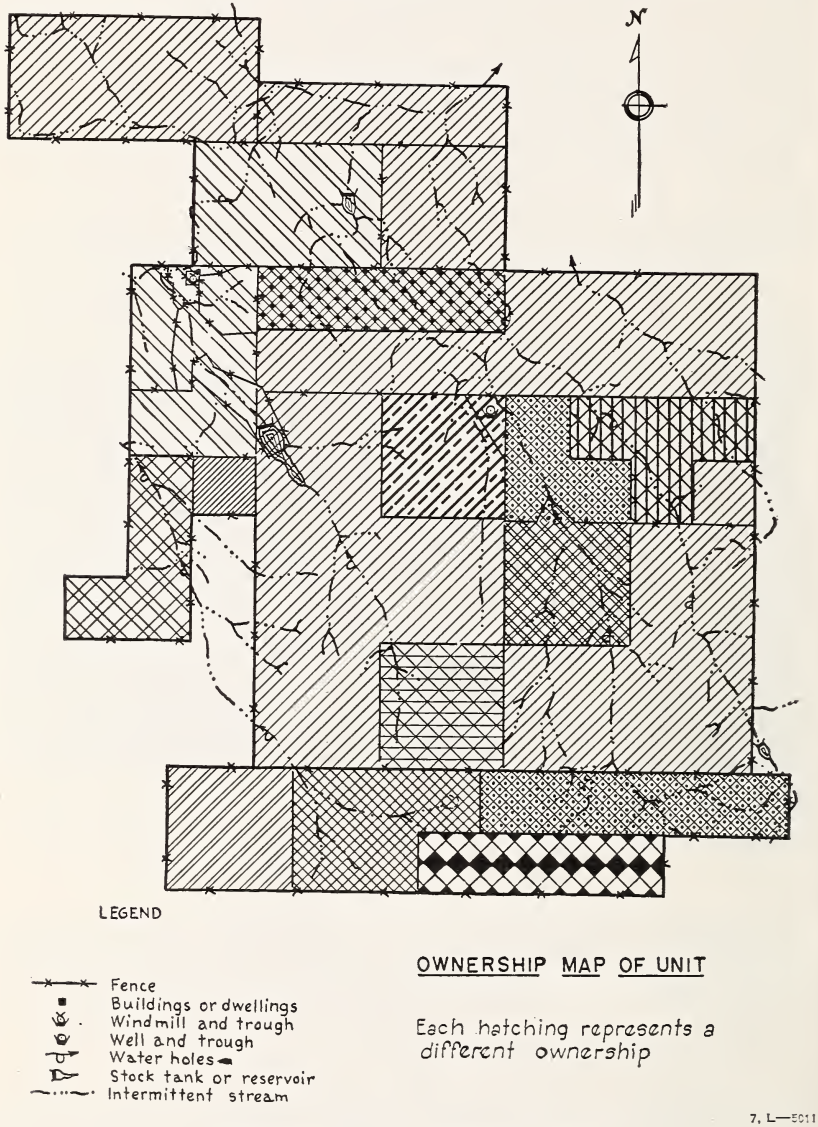

FIGURE 9.—Ownership map of unit.

Stockmen are finding it possible to overcome the obstacles to range conservation caused by checkered and abandoned land holdings by taking advantage of the soil conservation and range conservation legislation recently enacted. Opportunity is likewise afforded,

through the land-utilization projects of the Federal Government, to achieve a much-needed adjustment in range use. These projects, which are administered by the Soil Conservation Service, are managed primarily for the purpose of conserving the range in the interest of the public welfare, under policies which seek to stabilize the livestock industry of the region in which they are listed.

Heretofore the complex tenure of range-land ownership and range use has resulted in improper land use. Now stockmen are combining contiguous, abandoned, and uneconomic tracts into fewer, more soundly organized livestock ranching units. This development is graphically illustrated in figure 9, which shows how 13 undersized holdings in the soil conservation district near Faith, S. Dak., have been fitted together into one stabilized livestock-ranching enterprise.

RECOGNITION OF THE GREAT PLAINS RANGE PROBLEMS BY STOCKMEN

Stockmen and farmers are organizing themselves into voluntary groups to combat the forces that are destroying their grazing resources. The type of organization most widely accepted has been the soil conservation district which has become widely effective since most of the Plains States passed the standard soil conservation law. The purposes of this important piece of legislation are described in the following terms:

> An Act to declare the necessity of creating governmental subdivisions of the State, to be known as soil conservation districts, to engage in conserving soil resources and preventing and controlling soil erosion; to establish the State soil conservation committee, and to define its powers and duties; to provide for the creation of soil conservation districts; define the powers and duties of soil conservation districts, and to provide for the exercise of such powers, including the power to acquire property by purchase, gift, and otherwise; to empower such districts to adopt programs and regulations for the discontinuance of land-use practices contributing to soil wastage and soil erosion, and the adoption and carrying out of soil-conserving land-use practices, and to provide for the enforcement of such programs and regulations; to provide for establishing boards of adjustment in connection with land-use regulations, and to define their functions and powers; to provide for financial assistance to such soil conservation districts, and making an appropriation for that purpose; to declare an emergency requiring that this act take effect from the date of its passage, and for other purposes.

Already, 37 districts covering approximately 14 million acres of land have been established in the Great Plains. The hearty acceptance of this program is established by the fact that within 1 or 2 years many of the districts have doubled or trebled in size to enable neighboring ranchmen to benefit from the provisions of the law.

Another noteworthy expression of ranchmen's interest in voluntary range conservation is the passage of the Montana Grass Conservation Act, which makes possible the establishment of grazing districts in that State. This legislation is a development of the former Montana Grazing Association law, which was in effect for several years. The broad concepts of the law are summed up in the following excerpt from the Montana Grass Conservation Act:

> This act creates the Montana Grass Conservation Commission to conserve, protect, restore and properly utilize grass, forage, and range resources of the State. It regulates the formation, policies and administrative procedure of all State cooperative grazing districts. The Commission is the medium through

which the districts cooperate with federal, state and county agencies. It acts in an advisory capacity with the State Land Board and County Commission in formulating land conservation and stabilizing policies.

There are 35 grazing districts operating in Montana. At present there is a total of 12,244,587 acres of land under the jurisdiction of these districts. Seventeen hundred and sixty-two operators have membership in them and a total of about 89,493 animal units graze on district range lands.

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